# UNITED STATES PATENT APPLICATION

of

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for

# TWO-DIMENSIONAL TETHER RETAINER WITH ACCOMPANYING TOOLING ASSEMBLY

# TWO-DIMENSIONAL TETHER RETAINER WITH ACCOMPANYING TOOLING ASSEMBLY

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a tether retainer that restrains a tether used as part of a side-airbag system. More specifically, the present invention relates to a novel tether retainer that is designed to retain the tether by enclosing a portion of the tether within the retainer.

### 2. Description of Related Art

Inflatable airbags are well accepted for use in motor vehicles and have been credited with preventing numerous deaths and injuries. In fact, the inclusion of inflatable safety restraint devices, or airbags, is now a legal requirement for many new vehicles. Airbags are typically installed throughout the passenger cabin of a vehicle, including the steering wheel. In the event of an accident, an accelerometer within the vehicle measures the abnormal deceleration and triggers the expulsion of rapidly expanding gases from an inflator. The expanding gases fill the airbags, which quickly inflate in front of the driver and passenger to protect them from impact against the windshield, dashboard, steering wheel, or other portions of the vehicle. Side impact airbags, such as curtain airbags, have also been developed in response to the need for protection from impacts in a lateral direction or against the side of the vehicle.

Recently, airbag technology has continued to advance such that curtain airbags are now enlisted to provide roll-over protection. During a roll-over accident, the vehicle occupants can be jostled considerably, thereby causing the occupant to impact various parts of the vehicle interior. Even worse, the occupant may be ejected from the vehicle. Alternatively, a head or limb of an occupant may extend outside the vehicle during the roll-over. Such "occupant excursion" during roll-over accidents is a common cause of automotive fatality, particularly in the case of vehicle occupants that are not wearing a seat belt during the roll-over.

Conventional curtain airbags attempt to combat the dangers of side impact or roll-over accidents by having a curtain airbag unroll or unfold downward from the roof of the vehicle and then inflate beside the person as a means of preventing the person from hitting the door, the window, or the side of the vehicle during lateral impact. Since a vehicle occupant may be leaning forward, reclined in the seat, or at any position in between, such airbags are typically long enough to cover the whole interior side of the vehicle, protecting occupants in both the front and rear occupant seats.

Generally, the curtain airbags must be sized to hold large volumes of inflation gas and descend below the window sill. Consequently, when not inflated the curtain airbag includes a significant amount of material. This material is then rolled, folded, or otherwise gathered to form a tight, tubular bundle. A sock that fits around the curtain is also added to ensure that the curtain airbag is kept rolled or folded.

Additionally, the curtain airbag is also connected to tethers that tethers that extend from the ends of the airbag to anchoring points within the vehicle. These tethers are designed to protect the occupant by applying tension to the inflatable cushion to secure

the inflatable cushion between the occupant and the lateral surface of the vehicle during the crash. More specifically, the tethers are designed to secure the inflatable curtain in the proper position, thereby preventing the inflatable curtain from becoming positioned in a location that does not render maximum impact protection to the vehicle occupant during a crash.

The tethers are preferably attached to the vehicle interior through the use of one or more tether retainers. These retainers are usually extruded, punched components such as brackets, jigs, and the like that are attached and/or fit to the body of the vehicle. Preferably, the retainers are designed to engage and hold the tether in the proper position so that the tether may be permanently affixed to the vehicle via bolts, screws, nails, and/or other types of fasteners.

Experience with tethering systems has shown that in order for the tether to properly tension the inflatable curtain during a crash, the tether must be adequately retained and/or captured by the retainer. One method of accomplishing this retention of the tether is by constructing the retainer such that a portion of the tether may be taped or otherwise connected to a portion of the retainer. However, such a method of retaining the tether has a significant disadvantage in that as the connection between the tether and the retainer may deteriorate, there is an inherent risk that the retainer will not satisfactorily retain the tether over the life the vehicle.

More recent designs of retainer have attempted to retain the tether within the retainer through the use of a lock. This lock is a portion or section of the retainer that is designed to close or trap a portion of the tether. More specifically, the lock is designed

such that during the assembly and/or installation process, an airbag installer can manually close the lock and bind a portion of the tether within the retainer.

As with previous designs however, significant limitations and drawbacks arise in using a retainer having a manually closing lock. For example, in most of these retainers having locks, the process by which the airbag installer may close the lock around a portion of the tether is a very arduous, time-consuming, and labor intensive. Even working together, it will likely take multiple employees several minutes to install each airbag unit using these known retainers or they will have to position the tether within the retainer, close each lock around the tether, and then permanently attach to the retainer and the tether to the vehicle. As the manufacturer incurs costs for every moment that passes during the manufacturing process, these several minutes drastically raise the total production costs and reduce the manufacturer's overall profit margin.

Additionally, because the process of closing the locks around the tether is very difficult and arduous, using retainers having locks increases the likelihood that the retainer and/or the tethering system will be improperly installed onto the vehicle. Such improper installation may cause the tethering system to malfunction and/or fail to provide a vehicle occupant with optimal impact protection.

Known tether retainers that use locks to enclose a portion of the tether have a further limitation in that the locks used in such retainers are not foolproof. Even when properly installed and closed around a tether, these locks have a tendency to open or break due to the stresses and vibrations associated with a crash and/or the normal operation of the vehicle. If this lock opens or breaks, the retainer will be incapable of

sufficiently retaining the tether and any possible safety benefits of the tethering system is effectively eliminated.

Accordingly, there is a need in the art for a novel tether retainer that addresses and/or solves one or more of the above-listed problems. Such a device is disclosed herein.

## SUMMARY OF THE INVENTION

The apparatus of the present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available tether retainers. Thus, the present invention to provides a tether retainer that is designed such that all or a portion of a tether may be enclosed within the retainer.

In general, the retainer comprises two sections or portions: a base and a flap. The flap is attached to the base. Preferably, the flap is positioned below the base and is constructed such that it may be folded over the base along a tear seam.

The retainer further comprises a slot and a locking tab. More than one slot and/or more than one locking tab may also be used. The slot is positioned on the flap whereas the locking tab is positioned on the base. The locking tab is cut or otherwise configured such that it may be raised or bent into an extended position that is perpendicular and/or angled with respect to the base.

The locking tab is constructed to pass through the slot and cause the retainer to enclose a portion of a tether. More specifically, the locking tab is constructed such that if

it is raised into the extended position, the locking tab may pass through the slot and cause the retainer to enclose the tether between the base and the flap.

A mounting portion may additionally be added to the retainer. The mounting portion positioned proximate the base and may include one or more bolt holes. Preferably, the mounting portion and the bolt holes are configured such that one or more bolts may mount the retainer to an interior vehicle surface by passing through the bolt holes.

The retainer may further include a clearance hole. More than one clearance hole may also be used. The clearance hole is positioned on the base proximate one or more gripping tabs. The clearance hole and the gripping tabs are designed to orient and/or align to ensure that the retainer is properly aligned during the assembly and/or the installation process.

Preferably, the retainer is constructed such that it may be nested in a tooling assembly. As used herein, the term "nested in the tooling assembly" means that the retainer has been positioned, placed, or otherwise fit onto the tooling assembly.

The tooling assembly includes a receiving portion. The receiving portion is a portion or section of the tooling assembly that is designed to receive the retainer. More specifically, the receiving portion is designed such that when the retainer is nested in the tooling assembly, all or a portion of the retainer contacts and/or is positioned upon the receiving portion.

The tooling assembly further comprises a positioning blade that is added to the receiving portion. More than one positioning blade may also be used. The positioning blade is designed to position the locking tab. Preferably, the positioning blade extends

upwardly away from the receiving portion such that when the retainer is nested in the tooling assembly, the positioning blade raises and/or moves the locking tab into the extended position.

An alignment pins may also be added to the tooling assembly. More than one alignment pin may also be used. The alignment pin is positioned on or proximate to the receiving portion. Preferably, the alignment pin extends upwardly away from the receiving portion such that when the retainer is nested in the tooling assembly, the alignment pin passes through the clearance hole.

Once the retainer is nested in the tooling assembly, a tether may be positioned on the retainer. Preferably, the tether is positioned on the retainer such that all or a portion of the tether is situated on the base. The flap may then be folded over the base along the tear seam such that a portion of the tether becomes enclosed within the retainer between the flap and the base.

After the flap has been folded over the base, the locking tab and the positioning blade may be passed through the slot. This may be accomplished by using a press. The press is a component of the tooling assembly that may be lowered and/or moved such that it contacts the retainer. Preferably, the press is constructed such that when it contacts the retainer, the press pushes against the flap and ensures that the positioning blade and/or the locking tab pass through the slot.

In some embodiments, one or more tips may also be added to the locking tab. The tips are corners or sections of the locking tab and extend past the edge of the slot. Preferably, the tips are constructed such that once the locking tab passes through the slot,

the tips engage the flap and ensure that the tether remains enclosed between the flap and the base.

These and other features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

## BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above-recited and other features and advantages of the invention are obtained will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a perspective view of a tether retainer according to the present invention;

Figure 2 is a perspective view of the retainer of Figure 1 in which the retainer has been nested in a tooling assembly;

Figure 3 is a perspective view of the retainer of Figure 2 after the retainer's flap has been folded over the retainer's base;

Figure 4 is a perspective view of the retainer of Figure 3 in which the tooling assembly's press has been lowered onto the retainer;

Figure 5 is a perspective view of the retainer of Figure 4 in which a tether has been enclosed within the retainer; and

Figure 6 is a perspective view of manner in which the retainer of Figure 5 may be mounted to an interior surface of a vehicle.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The presently preferred embodiments of the present invention will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the apparatus, system, and method of the present invention, as represented in Figures 1 through 6, is not intended to limit the scope of the invention, as claimed, but is merely representative of presently preferred embodiments of the invention.

Referring to Figure 1, a perspective view of a tether retainer 10 according to the present invention is depicted. The retainer 10 is made of a thin (0.030) plastic or other comparable material and is designed such that all or a portion of a tether (not shown) may be enclosed and retained within the retainer 10.

In general, the retainer 10 comprises two sections or portions: a base 12 and a flap 14. The flap 14 is attached to the base 12. Preferably, the flap 14 is positioned below the base 12 and is constructed such that it may be folded over the base 12 along a tear seam 16.

In Figure 1, the base 12 and the flap 14 are both shown as being substantially rectangular in shape. Those of skill in the art will recognize that these structures may have a wide variety of shapes within the scope of the invention. Specifically, the base 12 and the flap 14 may have a variety of shapes, sizes, and configurations including, round, triangular, quadrilateral, polygonal, or any other desired shape.

The retainer 10 further comprises a slot 18. More than one slot 18 may also be used. The slot 18 is an aperture or hole in the retainer 10 that is added to the flap 14. In the embodiments shown in Figure 1, the slot 18 is generally rectangular in shape and is positioned proximate the lower edge of the flap 14. Of course, other embodiments may also be made in which the slot 18 is shaped and/or positioned differently on the flap 14.

A locking tab 20 is also added to the retainer 10. The locking tab 20 is positioned on the base 12. Preferably, the locking tab 20 is cut or otherwise configured such that it may be raised or bent into an extended position that is perpendicular and/or angled with respect to the base 12 (see Figure 2).

The locking tab 20 is further constructed to pass through the slot 18 and cause the retainer 10 to enclose a portion of a tether (not shown). More specifically, the locking tab 20 is constructed such that if it is raised into the extended position, the locking tab 20 may pass through the slot 18 and cause the retainer 10 to enclose the tether between the base 12 and the flap 14.

Referring still to Figure 1, a mounting portion 26 may additionally be added to the retainer 10. The mounting portion 26 positioned proximate the base 12 and may include one or more bolt holes 28. Preferably, the mounting portion 26 and the bolt holes 28 are

configured such that one or more bolts (not shown) may mount the retainer 10 to an interior vehicle surface (not shown) by passing through the bolt holes 28.

The retainer 10 may further include a clearance hole 30. More than one clearance hole 30 may also be used. The clearance hole 30 is positioned on the base 12 proximate one or more gripping tabs 32. The clearance hole 30 and the gripping tabs 32 are designed to orient and/or align to ensure that the retainer 10 is properly aligned during the assembly and/or the installation process.

Referring now to Figure 2, the retainer 10 of Figure 1 is shown on a tooling assembly 40. More specifically, in Figure 2, the retainer 10 has been nested in the tooling assembly 40. As used herein, the term "nested in the tooling assembly" means that the retainer 10 has been positioned, placed, or otherwise fit onto the tooling assembly 40.

The tooling assembly 40 is made of metal, plastic, and the like and includes a receiving portion 42. The receiving portion 42 is a portion or section of the tooling assembly 40 that is designed to receive the retainer 10. More specifically, the receiving portion 42 is designed such that when the retainer 10 is nested in the tooling assembly 40, all or a portion of the retainer 10 contacts and/or is positioned upon the receiving portion 42.

In Figure 2, the receiving portion 42 is shown as a surface that is larger than the retainer 10. Those of skill in the art will recognize that this structure may have a variety of sizes, shapes and/or configurations within the scope of the invention. Specifically, embodiments may be made in which the receiving portion 42 is a surface that is smaller than the retainer 10. Still further embodiments may be made in which the receiving

portion 42 only contacts a portion of the retainer 10. Still further embodiments may be made in which the receiving portion 42 is curved or bowed section of the tooling assembly 40.

The tooling assembly 40 further comprises a positioning blade 44 that is added to the receiving portion 42. More than one positioning blade 44 may also be used. The positioning blade 44 is made of metal, plastic, and the like and is designed to position the locking tab 20. Preferably, the positioning blade 44 extends upwardly away from the receiving portion 42 such that when the retainer 10 is nested in the tooling assembly 40, the positioning blade 44 raises and/or moves the locking tab 20 into the extended position.

The tooling assembly 40 may additionally comprises an alignment pin 50. More than one alignment pin 50 may also be used. The alignment pin 50 is positioned on or proximate to the receiving portion 42 and is made of metal, plastic, and the like. Preferably, the alignment pin 50 extends upwardly away from the receiving portion 42 such that when the retainer 10 is nested in the tooling assembly 40, the alignment pin 50 passes through the clearance hole 30.

As seen in Figure 2, a tether 52 may also be positioned on the retainer 10. The tether 52 is added after the retainer 10 has been nested in the tooling assembly 40. Preferably, the tether 52 is positioned on the retainer 10 such that all or a portion of the tether 52 is situated on the base 12.

Referring now to Figure 3, the process by which the retainer 10 nested in the tooling assembly 40 may be used to mechanically enclose the tether 52 within the retainer 10 is illustrated in greater detail. Once the tether 52 is positioned on the retainer 10, the

flap 14 is folded over the base 12. More specifically, the flap 14 is folded over the base 12 along the tear seam 16 such that a portion of the tether 52 is enclosed within the retainer 10 between the flap 14 and the base 12.

Referring now to Figure 4, the next step in the process by which the tether 52 may be enclosed within the retainer 10 is illustrated. Once the flap 14 is folded over the base 12, the locking tab 20 and the positioning blade 44 are passed through the slot 18 in the flap 14. This may be accomplished by using a press 60. The press 60 is a component of the tooling assembly 40 that may be lowered and/or moved such that it contacts the retainer 10. Preferably, the press 60 is constructed such that when it contacts the retainer 10, the press 60 pushes against the flap 14 and ensures that the positioning blade 44 and/or the locking tab 20 pass through the slot 18.

In Figure 4, the press 60 is shown as two rectangular shaped shafts that may be lowered onto the retainer 10. Those of skill in the art will recognize that this depiction is representative a variety of differing shapes, configurations, structures, and materials that may be used to construct the press 60. In particular, any structure or element that is capable of contacting the retainer 10 and/or ensuring that the positioning blade 44 and the locking tab 20 pass through the slot 18 may be used as the press 60.

Referring now to Figure 5, the retainer 10 is shown after the positioning blade 44 and/or the locking tab 20 have passed through the slot 18. More specifically, Figure 5 shows the retainer 10 nested in the tooling assembly 40 after the press 60 has pushed against the flap 14 and/or ensured that the locking tab 20 and the positioning blade 44 have passed through the slot 18.

As can be seen in Figure 5, one or more tips 62 may be added to the locking tab 20. The tips 62 are corners or sections of the locking tab 20 and extend past the edge of the slot 18. Preferably, the tips 62 are constructed such that once the locking tab 20 passes through the slot 18, the tips 62 engage the flap 14 and ensure that the tether 52 remains enclosed between the flap 14 and the base 12.

Referring now to Figure 6, the retainer 10 with the enclosed tether 52 may be removed from the tooling assembly and mounted to an interior vehicle surface 70. This may be accomplished through the use of a fastener 72. More than one fastener 72 may also be used. Preferably, the fastener 72 passes through the bolt hole 28 and engages and/or is inserted into an opening 74 on the interior vehicle surface 70 such that the retainer 10 becomes mounted to the interior vehicle surface 70.

Referring now to Figures 1-6 generally, the present invention also provides an easy and efficient method for retaining a tether 52. First, a tether retainer 10 is obtained. Next, the tether 52 is placed on the base 12. Finally, the tether 52 is enclosed within the retainer 10. Preferably, this enclosing step is accomplished by folding the flap 14 over the base 12 and by passing the locking tab 20 through the slot 18.

In an alternate embodiment, the method for retaining a tether 52 may further comprises the step of nesting the tether retainer 10 in a tooling assembly 40. Preferably, the nesting step is accomplished before the tether 52 is placed on the base 12. Additionally, further embodiments may be made in which the enclosing step also comprises lowering the press 60 onto the retainer 10 to ensure that the locking tab 20 passes through the slot 18.

The present invention may be embodied in other specific forms without departing from its structures, methods, or other essential characteristics as broadly described herein and claimed hereinafter. The described embodiments are to be considered in all respects only as illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is: